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Simultaneous replacement of maxillary central incisors with Cerec biogeneric reference technique: A case report

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Abstract: Biogeneric Reference Technique (BRT) of the CEREC 3D v.3.8 software is an effective technique for single anterior ceramic crowns because it provides computer-controlled match of the tooth form to the contralateral tooth. BRT also enables the fabrication of two or more anterior all-ceramic crowns simultaneously. This clinical report demonstrates the clinical application of BRT for designing and milling two central incisors in one appointment using a single optical impression. After completing the virtual design of the first central incisor, it was copied and a mirror image was created. The second central incisor was designed using this replicated image and therefore a computer-controlled symmetry was obtained. The crowns were milled from monolithic feldspathic ceramic blocks and adhesively luted with dual-cured resin cement following dentin conditioning. At the two-year follow-up appointment, the restorations were intact, no adverse effects were noted, and the resultant appearance was highly satisfactory for the patient. A step-by-step protocol is described from design to cementation of these restorations.

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Simultaneous Replacement of Maxillary Central Incisors with CEREC Biogeneric Reference Technique

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Abstract

This clinical report demonstrates the effective usage of CEREC 3D system with the Biogeneric Reference Technique (BRT) for designing and milling two central incisors in one appointment. BRT allows the operator to copy the contra-lateral tooth and create a mirror image of it on the preparation. This feature permits symmetrical design through using the mirrored replicated image and it provides clinical benefits while restoring two central incisors simultaneously. A step-by-step protocol is described from design to cementation of these restorations.

Keywords: Adhesive cementation, Biogeneric reference technique, CAD/CAM, CEREC, Digital Dentistry, Esthetics

Introduction

The technological advances in the field of computer-aided design and computer-aided manufacturing (CAD/CAM) with digital imaging, software design, and milling have created an equivalent alternative to laboratory-generated indirect ceramic restorations. The CEREC 3D system (Sirona Dental Systems GmbH, Bensheim, Germany) is a chairside application of CAD/CAM technology for reconstructive dentistry. The system includes an acquisition unit consisting of a portable computer, the design software and an optical imaging system. The milling chamber with two diamonds, mills the final restoration from prefabricated blocks of either ceramic or polymeric restorative materials.¹⁻³

The virtual design of the restorations can be made with the four different design options of the CEREC 3D v.3.8 software, namely biogeneric, correlation, articulation and biogeneric reference.² The biogeneric reference technique (BRT) allows the practitioner to fabricate a restoration that is an exact match of the collateral tooth that can be especially useful when restoring anterior teeth.⁴ This technique is also practical for restoring two contra-lateral teeth at the same time to have an exact match.

The present case report demonstrates the effective usage of CEREC 3D system with the BRT for designing and milling two central incisors in one appointment.

Case Presentation

A 26 year-old female patient presented herself at the Department of Prosthodontics, Istanbul University with aesthetic concerns on her anterior teeth. Intraoral examination revealed that maxillary incisors restored with large composite resin restorations were aesthetically unacceptable (Fig. 1).

The aesthetic restorative plan in this case involved fiber post and core fabrication followed by all ceramic crowns, manufactured using the CEREC 3D system.

Radiographic examination indicated successful endodontic treatment with a relatively wide root canal. Initially, composite resin restorations were removed to reach the root canals (Fig. 2). Gutta percha was removed with a peaso reamer attached to a slow speed hand-piece, and subsequently, the post preparations were made with a drill (DC3 -White-Post DC drill; FGM, Joinville, SC, Brazil) to a depth of 8 mm. A proper-sized fiber post (#3 White Post DC; FGM) was selected according to prepared canal dimensions and then cut at the required length.

The root canal surface was etched with phosphoric acid gel (K-etchant Gel; Kuraray Medical Inc, Okayama, Japan) for 15 seconds, rinsed thoroughly, and dried with paper points. A thin, uniform coat of bonding resin (ED Primer II; Kuraray Medical Inc) was applied into the root canal with a microbrush (Microbrush X; Microbrush Corp, Grafton, Wis, USA), excess adhesive solution was absorbed with paper points and gently air dried. Silane (Monobond S; Ivoclar Vivadent, Schaan, Liechtenstein) was applied on the post surface and waited 60 seconds for its reactions. Dual-polymerized resin cement (Clearfil Esthetic Cement; Kuraray Medical Inc) was applied to the prepared post space with a lentulo spiral instrument, the post placed, and then photo-polymerized for 20 seconds (DEMI Led; Kerr Dental, Orange, Calif) with an intensity of 1100 mW/cm² (Fig. 3).

Core build-up was made from composite resin (Clearfil Photo Core; Kuraray Medical) for preparation of abutment tooth according to the manufacturer's instructions. The tooth restored with a post-and-core system was then prepared for the planned all-ceramic restoration with subgingival chamfer margins (Fig. 4). Prior to the optical impression, a retraction cord (#00 Pro Retrac; FGM) was soaked in aluminum

chloride (Hemodent; Premier Dental Products Co, Plymouth Meeting, PA) and placed in the sulcus for 5 minutes.

The designing of the restoration was started from tooth 11 by setting the CEREC 3D v.3.8 software for a crown in the biogeneric mode. Titanium-dioxide powder (CEREC Powder; Vita Zahnfabrik, Bad Säckingen, Germany) was applied to the prepared teeth and surrounding gingival tissues as an optical imaging agent. Titanium dioxide has high refractive index and ensures uniform scattering of the light. An optical impression was made with the digital camera of the CEREC 3D acquisition unit. In this case 5 images were sufficient to capture 6 anterior teeth. Optical images of the antagonist teeth were also made and the bite registration was recorded with buccal scanning technique (Fig. 5). The preparation and antagonist images were correlated with buccal bite registration images. Finally, a virtual articulator was created.

Designing the virtual restoration is similar to that of the traditionally performed at the laboratory. The first step is trimming the virtual model to attain a virtual die. Removal of the neighboring teeth in this manner reveals the interproximal margins in detail and also facilitates to shape interproximal contact points of the final restoration. Once the virtual die was approved, the preparation margins were outlined with the automatic margin finder option of the software and the insertion axis was determined (Fig. 6). The biogeneric crown proposal was then automatically seated to the virtual die. Interproximal and occlusal contact points were verified and desired changes were accomplished with software's design tools. In the milling preview (Fig. 7), the restoration was placed in the feldspar ceramic block (CEREC Blocs; Sirona Dental Systems GmbH) with the shade of S2M according to the CEREC Blocs shade guide.

While crown 11 was being milled, the software virtually cemented that crown, facilitating design of the next restoration. CEREC software was set in biogeneric reference mode. Trimming the virtual model,

drawing the margin lines and determining the insertion axis were all made in similar fashion as for crown 11. The CEREC software prompts the practitioner to mark the tooth to be replicated. The contra-lateral tooth was selected and the software mirrored that tooth to make an exact copy (Fig. 8). In the next step, the desired part of the contra-lateral tooth was outlined to give the software the information as to which part of the tooth to copy precisely (Fig. 9). The copied tooth was aligned in the virtual model with software's rotation and position tools that allowed manipulation of the crown in three axes. After verifying interproximal and occlusal contacts, the crown was milled from the feldspar ceramic block.

After completing try-in procedures in the patient's mouth, custom characterization (Vident Stain and Glaze Products; Vident CA) was accomplished and the restoration was fired according to the manufacturer's specifications. The restoration was initially dried at 600°C for 2 minutes in the ceramic furnace. Then the temperature was increased at the rate of 80°C/min for 4.26 minutes up to 955°C and the restoration was held at this temperature for 1.4 minutes. Cooling time was 3 minutes. The total glaze phase took approximately 11 minutes.

For the adhesive cementation, the ceramic crowns were etched with 5% hydrofluoric acid (IPS Empress ceramic etching gel; Ivoclar Vivadent) for 20 seconds, rinsed and air-dried. A thin layer of silane coupling agent (Monobond S; Ivoclar Vivadent) was applied on the conditioned surfaces for 60 seconds and air-dried. The ceramic crowns were then cemented with dual-polymerized resin cement (Clearfil Esthetic Cement) according to the manufacturer's instructions (Fig. 10).

Discussion

This clinical report describes a chair-side CAD-CAM technique, which enables simultaneous and symmetrical replacement of maxillary central incisors. Maxillary central incisors are the key features of an

aesthetic smile and should exhibit a high degree of symmetry across the midline.⁵ With conventional laboratory fabricated crowns, this is difficult to achieve and success largely depends on the skill of the dental technician. The BRT in the CEREC 3D v.3.8 software provides the line angles and incisal edge morphology of the contra-lateral tooth that are exactly duplicated with great ease and speed. The quadrant feature of the software enabled the completion of two central incisors in one visit using a single optical impression.⁶ The second crown was designed while its contra-lateral was milling. One visit restorations eliminates the need for provisional restorations, increases durability of adhesion to dental tissues and also reduces postoperative sensitivity.⁷

The survival rate of CEREC crowns milled from feldspar blocks has been reported to be 94.4% after 44.7 ± 10 months.⁸ The feldspar ceramic blocks used in CEREC restorations are fabricated under optimum controlled conditions. This provides a restoration with higher intrinsic strength by eliminating the material variation found in lab-fabricated restorations.⁹ According to the manufacturer's information the flexural strength of the ceramic blocks is 154 MPa. In a previous clinical study,⁸ it was concluded that adhesively cemented CEREC feldspar ceramic crowns have provided clinical performance similar to that of ceramic core crowns. This was related to the high mechanical properties of the resin cement and the adhesion established at the interfaces between ceramic, resin cement and tooth structure.¹⁰

Staining technique was used for color matching of the milled ceramic crowns. Grinding of milled ceramic crowns for the layering ceramic can cause loss of replicated details in tooth morphology. This can adversely affect the adequate match between central incisors. In a previous study,¹¹ crowns fabricated from machinable blocks were compared with the restorations obtained by an individual layering technique and it was found that layering and non-layering techniques make little to no significant difference in aesthetics.

One advantage of the technique described here, is chairside color matching of the ceramic restorations. One of the main problems with the laboratory fabricated indirect ceramic restorations is communicating the hue, chroma, value, translucency, and texture with the technician. It is a time consuming step and may require multiple visits. Digital photographs, drawings and special instructions were often used to help the dental technician to understand the adjacent tooth morphology and color.¹² With this chairside technique described, the characterization procedures can be controlled with the various colors available in the system. In case the stain does not look correct, it can be easily rinsed off and reapplied.

In this case report we have used the CEREC 3D v.3.8 software. The second central incisor was designed with the “quadrant option,” of the software and by duplicating the first central incisor using the biogeneric reference mode of the software. The latest version of the software (4.0.2) has no “quadrant option,”. Therefore, it is not possible to virtually cement the first restoration and to select the first restoration as the teeth to be duplicated. With the latest version of the software, two central incisors can also be designed simultaneously but copying and mirroring the first restoration is not allowed. Thus, a completely computer guided symmetry cannot be accomplished with this version of the software. Latest software for CEREC 3D may consider implementing the “quadrant option,” for fabrication of ceramic crowns in single appointment using BRT technique.

Continued observation and addition of cases will be necessary to extend the data-base and provide more evidence for the reliability of the new CAD-CAM restoration techniques employing BRT technique.

Conclusions

This case report presented restoration of maxillary central incisors using feldspar ceramic crowns fabricated using the Biogeneric Reference Technique (BRT) mode of the CEREC 3D system. Such

restorations could be accomplished in one session, without compromising the adhesion as no temporary phase is required. The described method can be especially useful for fabrication of symmetric teeth where an exact match is required.

Disclosure

The authors declare that they have no financial interest in the companies whose materials are used in this article.

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Captions to the legends:

Figures:

Fig 1 Maxillary central incisors with large composite restorations.

Fig 2 Situation after removal of composite restorations.

Fig 3 Fiber posts cemented to the prepared post space with dual polymerized resin luting agent.

Fig 4 Situation after core build-up and tooth preparation.

Fig 5 Optical impressions of the prepared maxillary central incisors and antagonist teeth. Digital bite registration was made with buccal scan technique.

Fig 6 Determining insertion axis of the virtual crown.

Fig 7 Milling preview of the virtual crown placed in ceramic block.

Fig 8 Mirroring the morphology of the reference tooth.

Fig 9 Drawing the copy line.

Fig 10 Final restorations after adhesive cementation.

Figures:



Fig 1 Maxillary central incisors with large composite restorations.



Fig 2 Situation after removal of composite restorations.

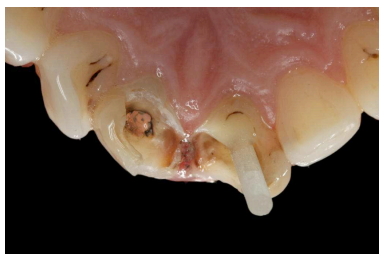


Fig 3 Fiber posts cemented to the prepared post space with dual polymerized resin luting agent.



Fig 4 Situation after core build-up and tooth preparation.

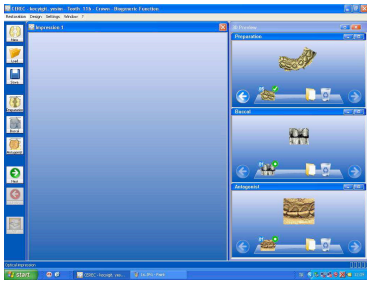


Fig 5 Optical impressions of the prepared maxillary central incisors and antagonist teeth. Digital bite registration was made with buccal scan technique.

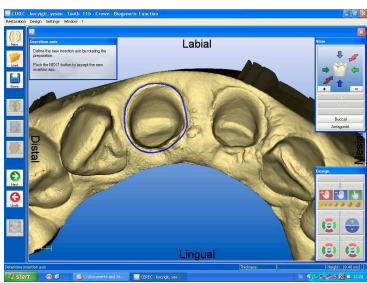


Fig 6 Determining insertion axis of the virtual crown.

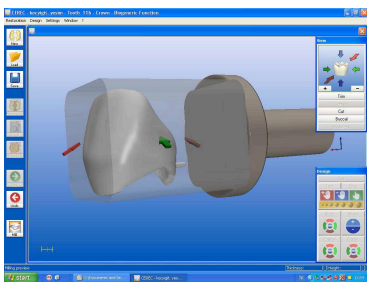


Fig 7 Milling preview of the virtual crown placed in ceramic block.

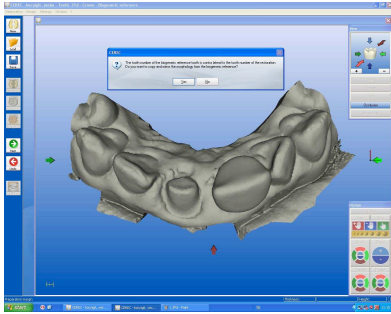


Fig 8 Mirroring the morphology of the reference tooth.

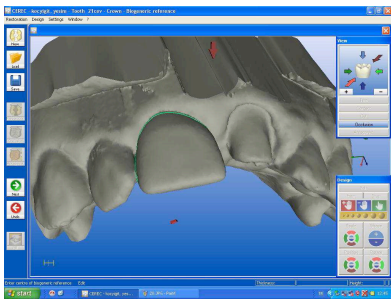


Fig 9 Drawing the copy line.



Fig 10 Final restorations after adhesive cementation.